# REPORT AND STATUS OF CADD FOR THE USACE AND TRI-SERVICE ENGINEERING DISCIPLINES: WHERE ARE WE NOW?

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## INTRODUCTION

The Tri-Service CADD/GIS Technology Center (TSTC) was established October 1992, at Waterways Experiment Station's (WES) Information Technology Laboratory (ITL) in Vicksburg, Mississippi. Previously, the Tri-Service Center was known as the Corps CADD Center. Because of the increase in partnering efforts throughout the Department of Defense, the Tri-Service Center was founded to coordinate the CADD/GIS activities of the Air Force, Army, Corps of Engineers, and the Navy.

Currently, the TSTC has 8 Field Working Groups (FWG), each representing a different discipline or field of expertise. The members selected for these groups by Headquarters personnel represent the field in deciding the direction the TSTC takes with regard to projects. When a product is produced by the Center, it is up to those FWG members to promote the implementation of that product within their own offices and throughout their service. The current FWGs are: Design, Construction, Facility Management, Environmental, Natural and Cultural Resources, Civil Works, Military Planning, and Systems. Each FWG is comprised ideally of the following Tri-Service representation: 4 Corps of Engineers members, 2 Army members, 2 Air Force members, and 2 Navy members.

CURRENT DESIGN FIELD WORKING GROUP COMPOSITION

The current Design Field Working Group is comprised of the following people:

Members:

- Corps: Stan Shirk, Omaha District
  Marsha Walkup, Kansas City District
  Richard Allwes, Pittsburgh District
- Air Force: Brenda Langheld, Brooks AFB
  Linda Mracek, Hurlburt Field
  James Roesch, Grand Forks AFB
  Larry Strother, Tyndall AFB
- Navy: Gary Boyd, Southern Division

Omar San Antonio, Atlantic Division
Karen Jones, Naval Surface Warfare Center

## DESIGN FIELD WORKING GROUP TASKS

The Design FWG had two main tasks that they worked on over the past two years. These tasks were the continued development of the *Tri-Service Architectural, Engineering, and Construction (A/E/C) Computer-Aided Design and Drafting (CADD) Standards* and the compilation of details for the *CADD Details Library*.

TRI-SERVICE A/E/C CADD STANDARDS MANUAL

The *Tri-Service A/E/C CADD Standards* manual is the result of the compilation of various CADD standards developed throughout the tri-service. The main challenge in creating a CADD standard is creating one generic enough to be used in either Intergraph's MicroStation or Autodesk's AutoCAD. The Tri-Service Center has had many sources of feedback regarding the standards. These include: the Tri-Service Design Field Working Group, the Corps of Engineers' Field Advisory CADD (FAC) groups, the National Institute of Building Sciences' (NIBS) CADD Council, and the U.S. Coast Guard. In April of 1995, the TSTC released Version 1.4 of the Standards. This version was generally well received, but has recently been released in a 1.7 version for review. The latest revisions to the standards include different file naming methods, differentiation between model files and sheet files, and a reorganization of the existing symbol library.

### Disciplines

The first decision made by the Center for Version 1.4 was to determine which disciplines would be included in the standards. Some disciplines, such as the Mechanical and Electrical disciplines, had to be divided into subdisciplines (e.g., HVAC, Plumbing, Fire Suppression, and Specialty for Mechanical; and Lighting, Power, Communications, and Site for Electrical). Each of these disciplines or subdisciplines would have particular drawings associated to them in the development of a project. These drawings would have a maximum of 63 levels/layers because of MicroStation's level constraint. Information from other disciplines would be referenced to create the final drawing sheet, such as an architect's Floor Plan for the building walls. Even the Border Sheet is referenced in order to use the same border sheet over and over.

Based on changes to the American Institute of Architects' *CAD Layer Guidelines* document and recommendations made by South

Atlantic Division, the Mechanical and Electrical subdisciplines have been reevaluated. Plumbing and Fire Protection/Suppression, which were previously subdisciplines, have been upgraded to disciplines. The Electrical Site subdiscipline has been incorporated into the new Utilities discipline.

**Model Files Vs. Sheet Files**

One new concept promoted in Version 1.7 of the standards is the differentiation of model files and sheet files.

Model Files

Model files contain elements/systems that comprise information about a building (e.g., floor plans, HVAC plans, Lighting plans, details, schedules, etc.). This model information is drawn full size and then referenced to create other model files (e.g., a floor plan would be referenced by the mechanical engineer to lay out the building's ductwork). Model files can be considered 'work-in-progress' (i.e., the ductwork layout will be revised based on changes to the architect's floor plan). Border sheets are also considered to be model files, since they are referenced by all disciplines in compiling a sheet file.

Sheet Files

Sheet files are the final plots for a set of construction drawings. Sheet files are comprised of referenced model files with the addition of sheet-specific text/symbols (e.g., north arrows, scales, titles, title block information).

**Level/Layer Naming**

For the naming of levels/layers, the level/layer naming guidelines in the American Institute of Architects' publication *CADD Layer Guidelines, Recommended Designations for Architecture, Engineering, and Facility Management Computer-Aided Design* were followed. This file naming convention allows a level/layer name with up to 16 characters. The basic level/layer name appearance is: X-XXXX-XXXX-XXXX. The first character denotes the Discipline Code (Mechanical, Plumbing, Electrical, etc.). For the Mechanical disciplines, the Discipline Codes are M for Mechanical, P for Plumbing, and F for Fire Protection/Suppression. For the Electrical disciplines, the Discipline Codes are E for Electrical, T for Telecommunications, and U for Utilities. The first set of four characters denote the Major Group, typically objects, assemblies, or construction systems (e.g., ductwork, lights, piping). The second set of four characters comprise the Minor Group for the level/layer. This

modifier further differentiates the type of information placed on that level/layer, (i.e., supply ductwork versus return ductwork). The final set of four characters denotes Status information about the level/layer. Because of MicroStation's limit of 63 levels per design file, the Tri-Service standards do not promote using the Status Field.

Some examples of levels/layers:

M-DUCT-SUPP Supply ductwork
M-DUCT-RETN Return ductwork
M-CWTR-PIPE Chilled water piping
M-CWTR-EQPM Chilled water equipment
E-LITE-CLNG Ceiling mounted fixtures
E-LITE-EXIT Exit fixtures

**Level/Layer Colors and Line Widths**

Since AutoCAD users rely on pen tables based on color to map line weights, each color in the standard had to be assigned a particular line weight. The line weights selected for the *Tri-Service Architectural, Engineering, and Construction (A/E/C) Computer-Aided Design and Drafting (CADD) Standards* ranged from 0.18mm to 1.60mm and 8 colors were chosen to be mapped to these weights.

**A/E/C CADD Standards Symbology**

Currently, there are over 1600 symbols/patterns/objects/line types in the *Tri-Service Architectural, Engineering, and Construction (A/E/C) Computer-Aided Design and Drafting (CADD) Standards*. Objects, symbols and patterns are provided as MicroStation cell libraries (.cel) and AutoCAD blocks (.dwg). Custom line types are provided in MicroStation resource files (.rsc) or AutoCAD linetype library files (.lin).

**Workspace**

One main obstacle to the adoption of the Tri-Service Standards is the lack of implementation software available to ensure the compliance of the numerous level/layer tables it contains. One solution to this problem is the development of workspaces that make standards implementation invisible to the user. When the user selects the appropriate discipline, a discipline palette will appear. The user can then select palette buttons which result in the user being set up on the correct level/layer with the correct line weight/color/style without having to think about

it. A version of the MicroStation workspace is being developed with a similar version being developed for AutoCAD.

**National CADD Standards Effort**

The ultimate goal of the standards is to add this effort to that of the National Institute of Building Sciences (NIBS) in the development of a National CADD Standard. This standard will be comprised of standards created by the American Institute of Architects (AIA), the Construction Specifications Institute (CSI) and the Tri-Service CADD/GIS Technology Center. Eventually this effort would result in a standard that would be recognized as the A/E/C CADD standard for the United States.

CADD DETAILS LIBRARY

**Background**

The *CADD Details Library* is comprised of generic construction details in both AutoCAD .dwg and MicroStation .dgn formats. Currently, there are over 1400 CADD details representing the architectural; mechanical; electrical; hazardous, toxic, and radioactive waste (HTRW); structural; and civil/site disciplines. Future disciplines to be added include interior design, landscape architectural, and geotechnical. Because of the push toward developing designs completely in metric, over ½ of the existing library has been converted to metric.

The *CADD Details Library* was developed by the Tri-Service CADD/GIS Technology Center in response to requests from tri-service field personnel for a compiled library of CADD details. Prior to CADD, a draftsman could take days in developing a single sheet of details. With CADD, a draftsman can draw a detail once, save it to a file, and then reuse it on various projects in the future. A detail sheet can now take minutes to assemble instead of hours to draw by hand. This time savings to the engineer/draftsman results in cost savings to the government. Because of the space required to store all of these details, the *CADD Details Library* is being released on CD-ROM. Version 1.0 contained over 2400 details in both .dwg and .dgn format and only 1/3 of the available space was used, so there is plenty of disc space available for expansion. This CD-ROM can be shared amongst users or the contents can be downloaded to a server for use throughout a site. Version 2.0 of the *CADD Details Library* will be released in the summer of FY98. All new and revised details are also made available for downloading via the Internet at the following address: http://cadlib.wes.army.mil.

**CADD Detail Manager**

The CADD Detail Manager (CDM) was developed in order to give the user an easy method of retrieving and placing details contained within the *CADD Details Library*. The detail file names contained in the *CADD Details Library* are based on the *UniFormat* document (Interim Edition) produced by the Construction Specification Institute (CSI) and Construction Specification Canada (CSC). The CADD Detail Manager is structured on the *UniFormat* system for ease in file retrieval. Upon selecting a detail, the user can preview an image of the detail prior to placement. Since the details are drawn to different scales, a scaling option is available for ensuring that details are placed at the correct scale. The *CADD Details Library* is considered to be a "living" program in that details will continue to be added or removed as necessary. Requests for *CADD Detail Library* reports or the *CADD Details Library* CD-ROM should be submitted to the Tri-Service CADD/GIS Technology Center.

**THE FUTURE**

Future tasks for the Design Field Working Group will include continually updating the *CADD Detail Library* and reviewing future drafts of the *Tri-Service A/E/C CADD Standards.* One significant project that will be started in FY99 is the addition of American Institute of Steel Construction (AISC) details to the *CADD Details Library*. Through partnering efforts such as this, the Tri-Service Center can promote standards to professional societies as well as the DoD.

**CONCLUSION**

The Tri-Service Center and the Design Field Working Group has had a busy two years. It is through the development and promotion of standards and generic CADD detail libraries that the DoD can help in reducing cost and time spent on construction projects. If you have any questions regarding the Design FWG or would like to receive any of the Tri-Service CADD/GIS Technology Center products mentioned above please contact the author at the mailing address below.

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